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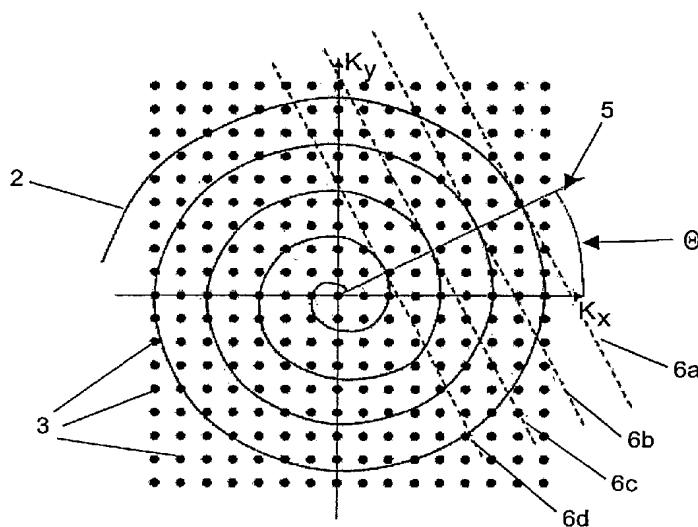
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(54) Title: MAGNETIC RESONANCE IMAGING METHOD



(57) Abstract: A novel magnetic resonance imaging method and apparatus is described wherein an image is derived from sub-sampled magnetic resonance signals and on the basis of the spatial sensitivity profile of each receiving antenna. A sequence of RF-pulses and gradients is applied, which sequence corresponds to a set of trajectories containing at least one substantially non-linear trajectory in k-space, wherein the density of said trajectory set being substantially lower than the density corresponding to the object size. Each signal along said trajectory set is sampled at least at two different receiver antenna positions. The image is reconstructed by converting the data of said signals to a Cartesian grid by convolution with a gridding kernel, whereby the gridding kernel is specific for each antenna, differs between one region and another in k-space, and is a Fourier-transform of a pattern weighted for each antenna with respect to the Cartesian grid.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/014889 A1 (PRUSSMANN KLAAS PAUL ET AL) 7 February 2002 (2002-02-07) cited in the application abstract paragraph '0015! - paragraph '0048! -----	1-21
A	US 2003/122545 A1 (VAN DEN BRINK JOHAN ET AL) 3 July 2003 (2003-07-03) cited in the application abstract paragraph '0025! - paragraph '0027! -----	1-21
P, A	WO 2004/104611 A (CASE WESTERN RESERVE UNIVERSITY; WONG, EDDY, Y; HILLENBRAND, CLAUDIA,) 2 December 2004 (2004-12-02) abstract paragraph '0035! - paragraph '0036! ----- -/--	1-21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>BYDDER M ET AL: "Generalized SMASH imaging"</p> <p>MAGNETIC RESONANCE IN MEDICINE, ACADEMIC PRESS, DULUTH, MN, US, vol. 47, no. 1, January 2002 (2002-01), pages 160-170, XP002204471</p> <p>ISSN: 0740-3194</p> <p>abstract</p> <p>page 160, column 1, paragraphs 1,2 - column 2, paragraph 2-4</p> <p>-----</p>	1-21

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2005/050458

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002014889	A1	07-02-2002	CN 1380983 A 20-11-2002
		WO 0173463 A1 04-10-2001	
		EP 1212633 A1 12-06-2002	
		JP 2003528666 T 30-09-2003	
US 2003122545	A1	03-07-2003	WO 0072036 A1 30-11-2000
		EP 1101127 A1 23-05-2001	
		JP 2003500135 T 07-01-2003	
		US 6593740 B1 15-07-2003	
WO 2004104611	A	02-12-2004	US 2005054913 A1 10-03-2005
		US 2005054914 A1 10-03-2005	
		WO 2004104611 A2 02-12-2004	
		US 2005074152 A1 07-04-2005	
		US 2005058368 A1 17-03-2005	
		WO 2005003805 A1 13-01-2005	